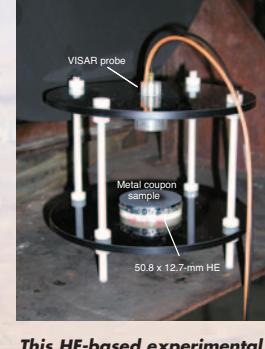


Contributing to Stockpile Stewardship

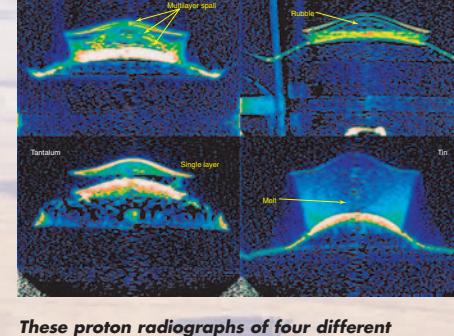
Dynamic materials studies and subcritical experiments

Proton Radiography

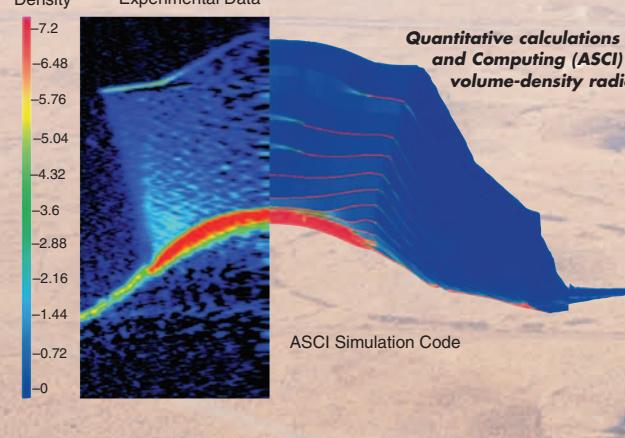
High explosive (HE) used in a weapon generates shock waves that interact with the metal components, thus damaging the material. The pressure profile in the HE behind the shock enters the metal components of the weapon and, on reflection from a free surface, can generate one or more layers of damaged "spall" material. Modern computer models of the dynamic properties of shock-damaged materials require experimental data to verify various aspects of the model. One powerful diagnostic tool used to make these comparisons is proton radiography, which measures the mass distribution of shocked/damaged metal as a function of time and provides quantitative measurements to compare to models.



This HE-based experimental geometry is used in a typical proton radiography experiment.



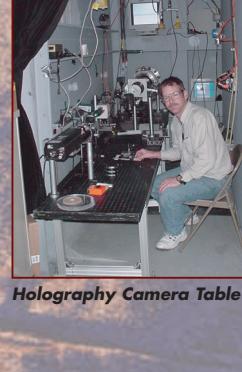
These proton radiographs of four different metals show the different types of damage that can occur. Very strong material (tantalum) produces one or two layers, whereas weaker material (copper and aluminum) produces multiple layers. Shock-melted tin cavitates and disperses as a result of the dynamic tension in the sample.



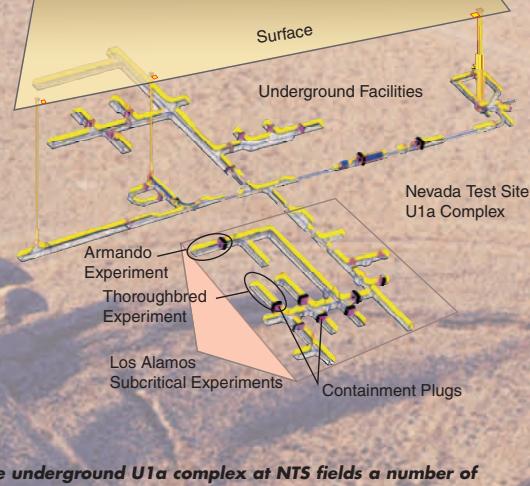
Quantitative calculations using Advanced Simulation and Computing (ASCI) codes are compared with the volume-density radiograph of shock-melted tin.

Subcritical Experiments

Subcritical experiments (SCEs) conducted in the U1a facility at the Nevada Test Site (NTS) involve the use of weapons-grade plutonium or other fissionable materials in studies that are conducted with amounts of plutonium in geometries that will not produce nuclear yield. Although SCEs may vary in purpose, they are generally designed to study a mockup of a weapons feature or the physical properties of the fissionable material. Physics Division has continued its historical role of experiment design and diagnostic development on the SCEs much as it had done on underground nuclear tests.



Holography Camera Table



The underground U1a complex at NTS fields a number of SCEs, including the "Armando" to radiograph spall in a piece of plutonium driven by HE and "Thoroughbred" to study particles propelled from a material's surface when the material is compressed by a powerful shock wave. "Thoroughbred" involved a complicated set of diagnostics, such as the holography camera shown at left, adapted by Physics Division for use in the U1a complex.